REPORT DOCUMENTATION PAGE	Form Approved OMB No. 0704-0188

1. AGENCY USE ONLY (*LEAVE BLANK*)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	4 June 1996	Professional Paper

4. TITLE AND SUBTITLE

E-6 HM/HS Tools

5. FUNDING NUMBERS

6. AUTHOR(S)

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7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

Commander
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8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

Naval Air Systems Command
Department of the Navy
1421 Jefferson Davis Highway
Arlington, VA 22243

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT

Approved for public release; distribution unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT (*Maximum 200 words*)

- E-6 Aircraft
- EMP Coupling
- Typical Aircraft Hardening Techniques
- TBNF-6F
- Transportable Cart

14. SUBJECT TERMS

E-6;E3 HM/HS Tools;EMP Coupling;Hardening Techniques

15. NUMBER OF PAGES

24

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	UL

NSN 7540-01-280-5500

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Enclosure (7)

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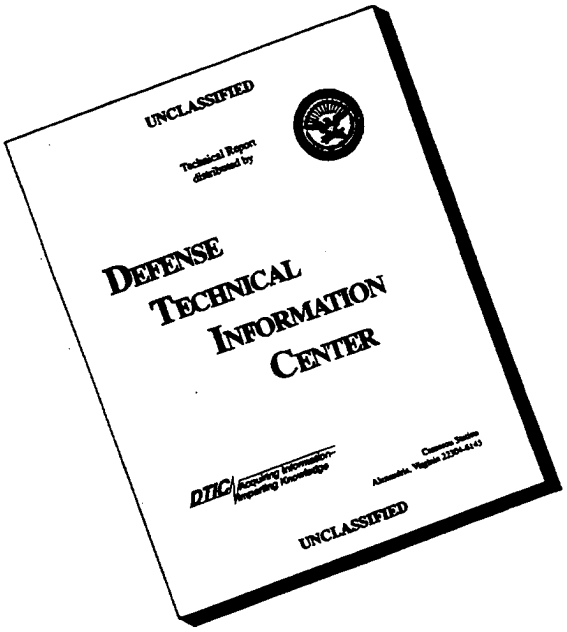

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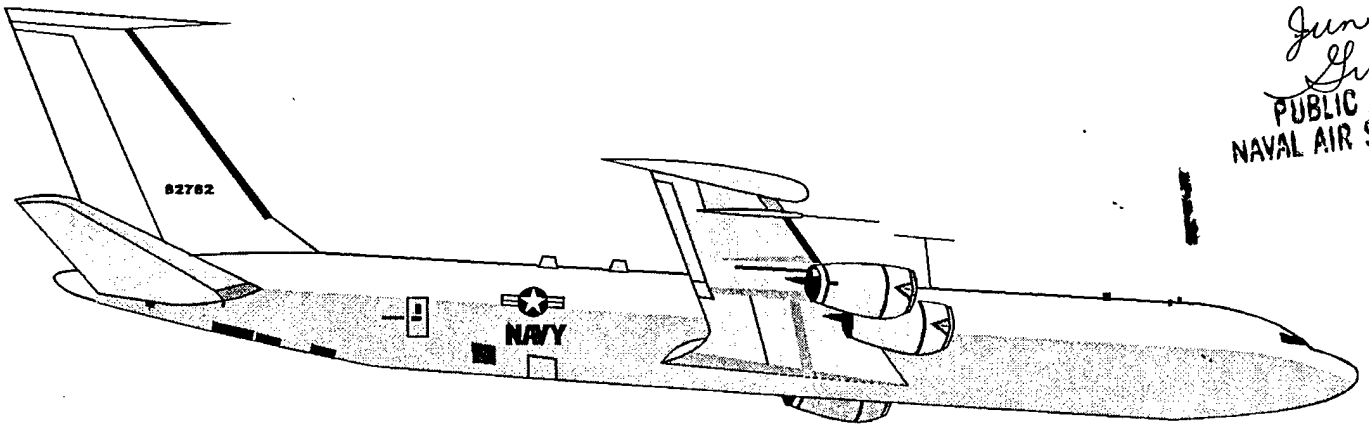
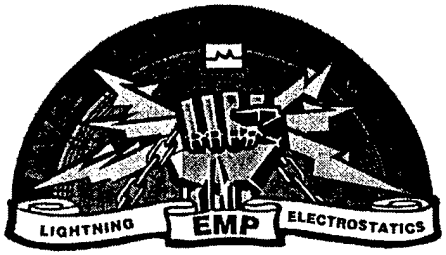
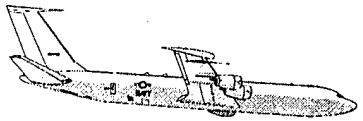
E-6
E³ HM/HS TOOLS



JOEL HAINES
MIKE CLELLAND



NAVAL AIR WARFARE CENTER AIRCRAFT DIVISION
PATUXENT RIVER, MARYLAND 20670-5304



E-6 AIRCRAFT

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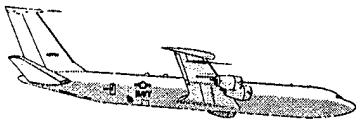
- The Design Is Based On The Commercial Boeing 707 And The Military E-3A Airframes
- Modifications And Special Equipment Installed To Support The Take Charge And Move Out (TACAMO) Strategic Communications Mission



E-6 AIRCRAFT

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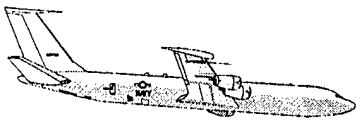
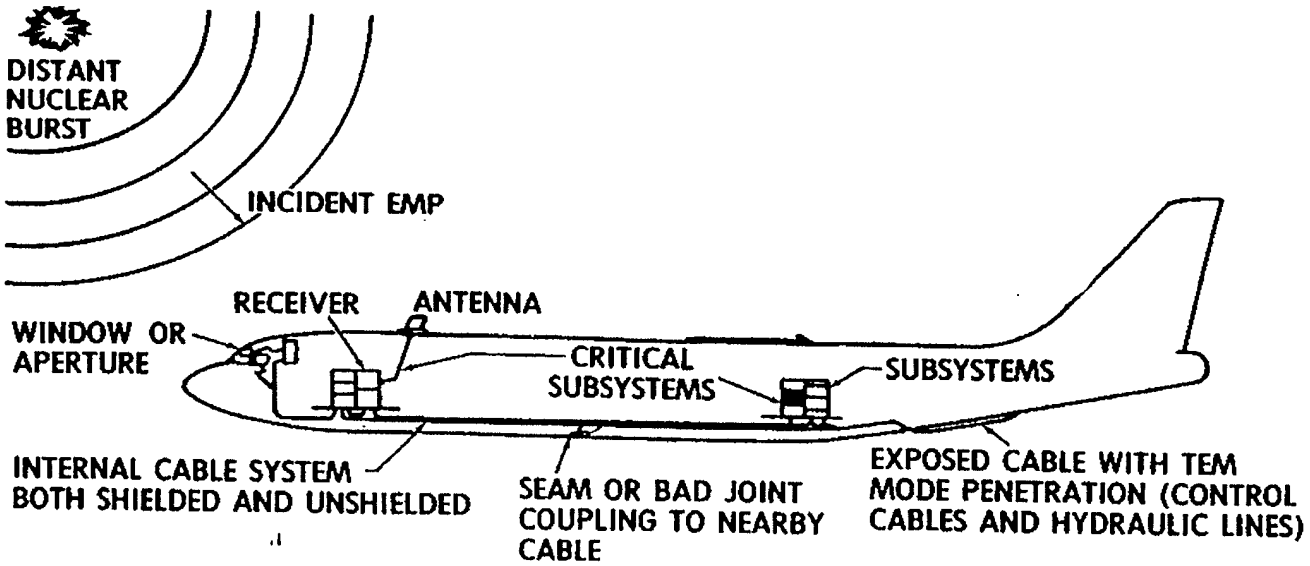
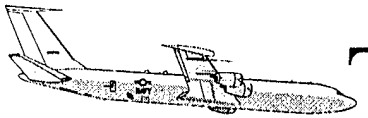
- The TACAMO Mission Is To Provide A Survivable Communications Link Between The Joint Chiefs Of Staff And The Ballistic Missile Submarine Forces



EMP COUPLING



- INCIDENT EMP CAUSES CURRENT AND CHARGES ON EXTERNAL SURFACE
- SURFACE CURRENTS AND CHARGES EXCITE ANTENNAS AND INADVERTENT PENETRATIONS
- PENETRATIONS COUPLE ENERGY TO INTERNAL CABLING
- CABLE SYSTEMS ROUTE ENERGY TO CRITICAL SUBSYSTEMS



TYPICAL AIRCRAFT HARDENING TECHNIQUES

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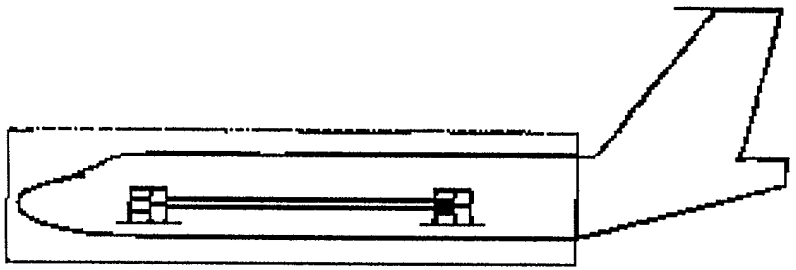
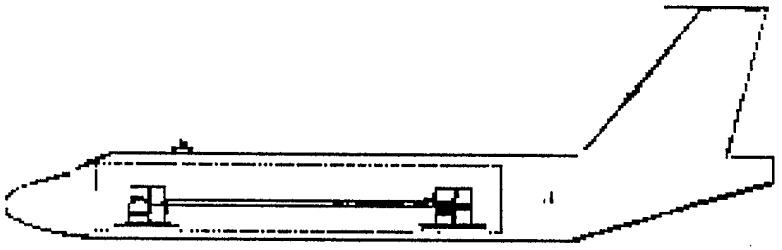
Reduce Stress



Layer 1

Hull Hardening

- Antenna hardening
- External wire hardening
- Mechanical penetration hardening

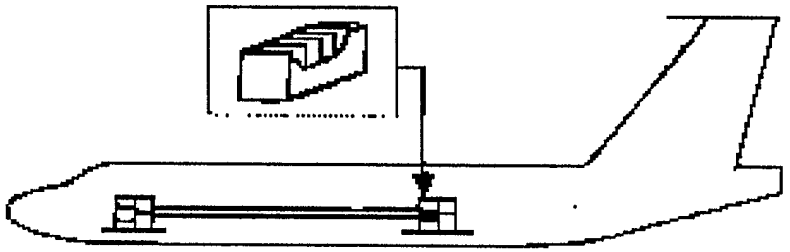


Layer 2

Internal Shielding

- Wire shielding
- Cabinet shielding

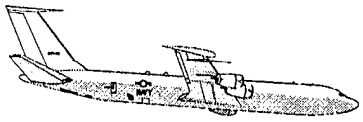
Increase Strength



Layer 3

Box Hardening

- Harden interface circuitry with diodes, filters
- Parts control



TBNH-6F

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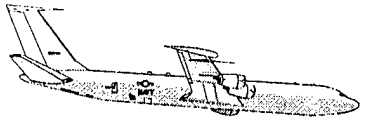
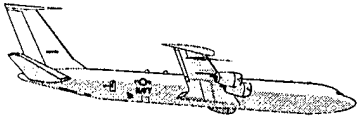
- BACKGROUND
  - The Test Bench Nuclear Hardness (TBNH-6F) was procured to test the Terminal Protection Modules Installed on the E-6A. The TBNH-6F is a adaptation of the TBNH-160F which is used by the French Air Force with the mission equivalent to that of the E-6A.



TBNH-6F

- FUNCTIONAL CHARACTERISTICS
  - Test Bench Allows Two Testing levels:
    - Organizational Level (TPM installed on the aircraft)
    - Depot Level (TPMs removed form the aircraft)
  - TPM characteristics tested:
    - attenuation, capacitance, inductance, resistance, firing voltage and leakage currents.



TBNH-6F

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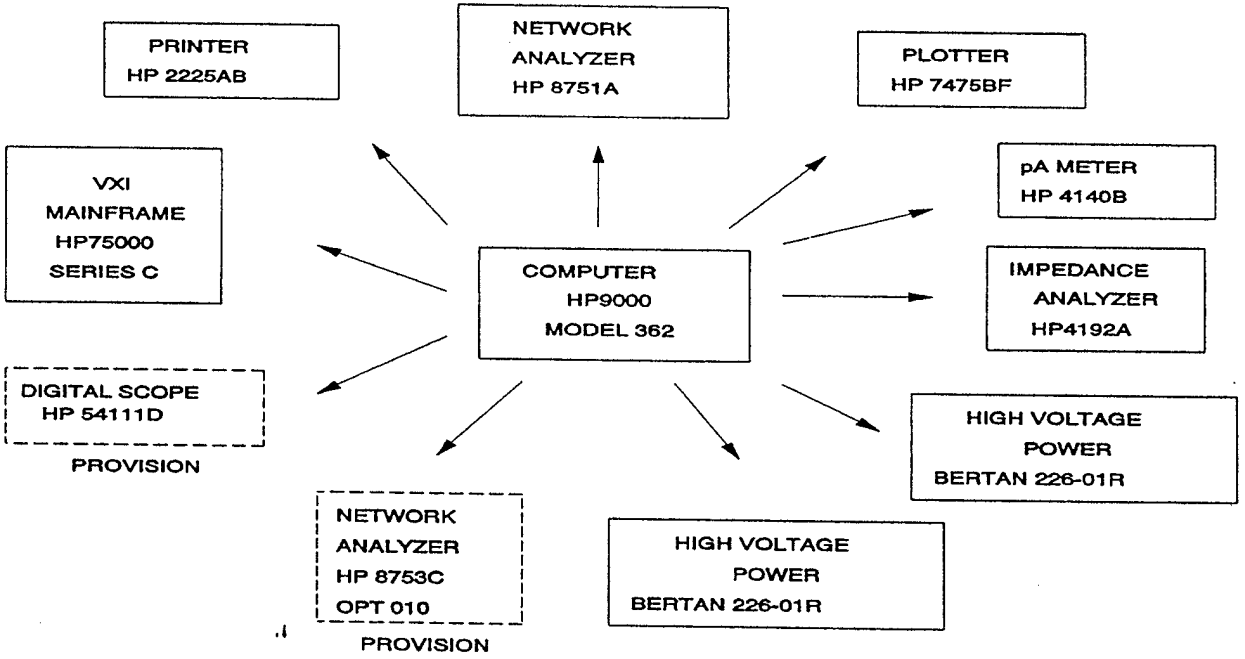

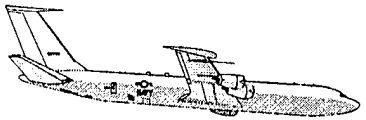

TBNH-6F

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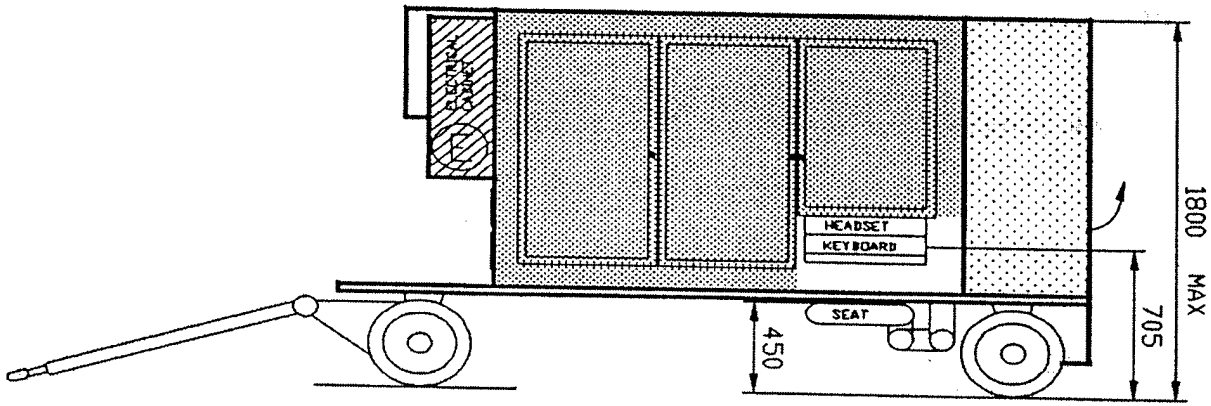
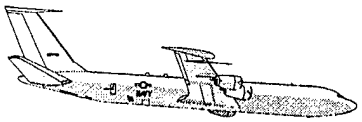
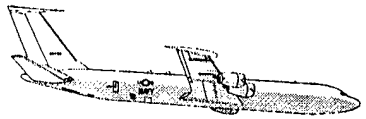


SECTION A B C D E



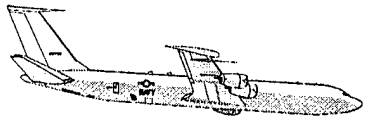
TBNH-6F

- TBNH-6F CONSIST OF:
  - Transportable Cart
  - Air-Conditioning System
  - Test Assembly



TRANSPORTABLE CART

- Divided Into 5 Sections:
  - Section A - This Section Includes The Air-Conditioning System And Power Supply
  - Section B - Includes A Height Adjustable, Retractable Seat, Computer Keyboard And The Headset Audio-Panel (For Audio Communications With The Remote Unit)
  - Section C - This Section Is A Rigid, Waterproof, Air-Conditioned Enclosure. The Cabinet Contains Three Parts Where Test Fixtures Are Mounted



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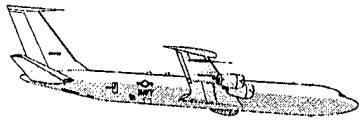
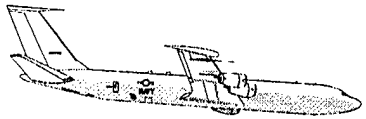
TRANSPORTABLE CART

- Divided into 5 Sections (Cont'd)
  - Section D - Includes The Lighting System, 2 Electrical Connectors, And Storage Space For Cables
  - Section E - Contains A Waterproof Main Power Control Cabinet, The Interface Panel, The Main Power Interface, And 2 Drums For Main Cables



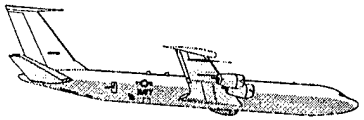
TRANSPORTABLE CART

- 1st Part of Cabinet
  - Picoammeter HP4140B
  - Picoammeter Interface
  - Switching Unit HP75000-C VX 1
  - Interface Module Interface



TRANSPORTABLE CART

- 2nd Part of Cabinet
  - Bertan Power Supply
  - HP 8751A Network Analyzer
  - Network Analyzer Interface
  - HP4192A Impedance Analyzer
  - Impedance Analyzer



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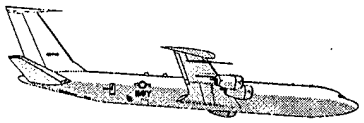
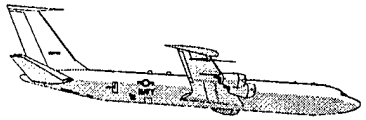
TRANSPORTABLE CART

- 3rd Part of Cabinet
  - Bertan Power Supply
  - HP D1194 Display
  - HP A2240A Computer
  - Non-interruptible Power System



TBNH-6F

- **Testing System**
  - Controlled by a HP 9000 model 362 through HPIB bus. HP basic software is used.
    - HP 8751A-Network Analyzer- allows TPM attenuation measurement (1dB accuracy) from 2kHZ to 150 MHZ.
    - HP 4140B- pA meter allows measurement of total leakage current (components, connectors, etc.), measurement of firing voltage of non-linear components up to 100 v.



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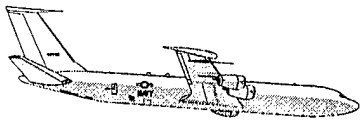
TBNH-6F

- Testing System (Cont'd)
  - HP 4192A - Impedance Analyzer- allows measurement of parallel capacitors and serial inductors with 1% accuracy.
  - Bertan H.V. PWR Supply - used for measurement of firing voltage of non-linear components for voltages higher than 100v.



TYPICAL TEST

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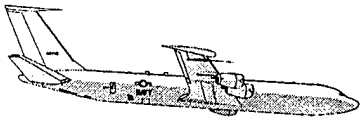
- Over 110 TPMs On Each Aircraft
- 15 - 30 TPMs Tested As Part Of EPM
  - Only One Section Of The Aircraft Goes Through EPM At A Time
  - The TBNH-6F Plots A Hard Copy And Saves All The Measured Data To A Disk



TPM LOCATIONS

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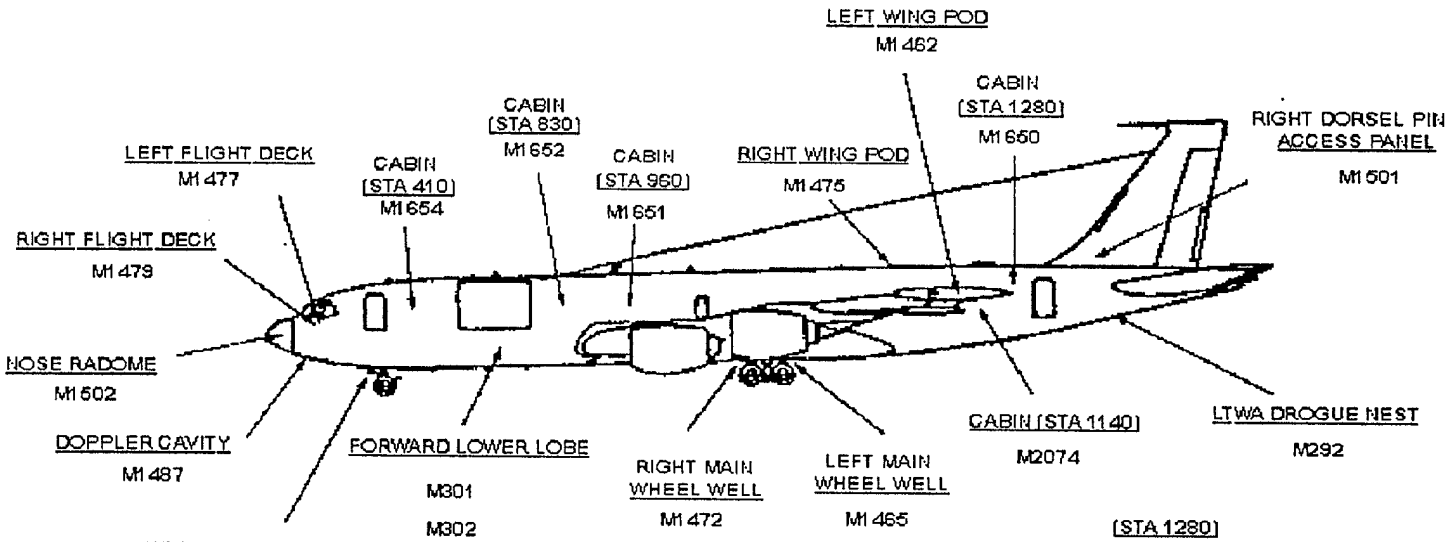
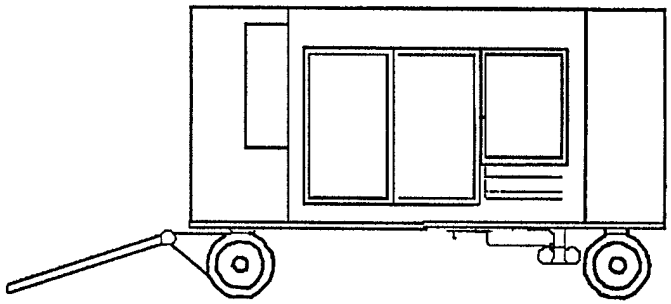
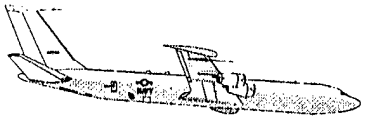
RIGHT WING POD
LEFT WING POD



FORWARD LOWER LOBE	RIGHT MAIN WHEEL WELL	LEFT MAIN WHEEL WELL
M301	M1472	M1465
M302	M1484	M1455
M303	M1470	M1468
M304	M1497	M1498
M313	M1483	M1486
M314	M1492	M1493
M315	M1461	M1457
M316	M1471	
M317		
M318		
M2068		
M2069		

(STA 1280)





TPM LOCATIONS

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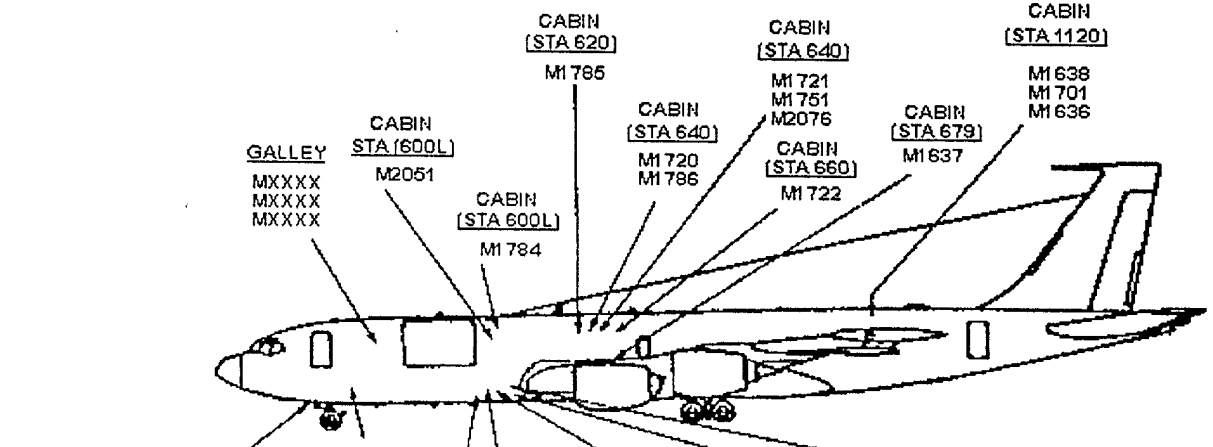
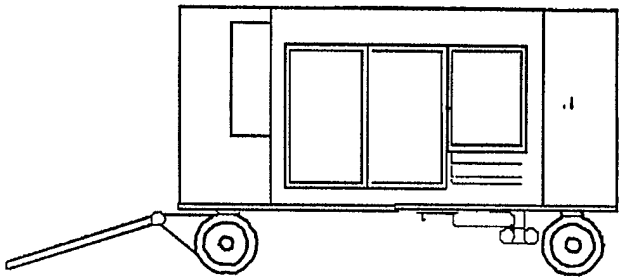
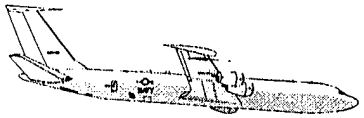




Internal TPMS



EXTERNAL TPMS

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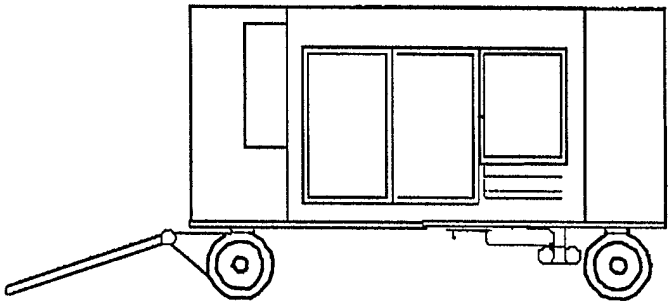
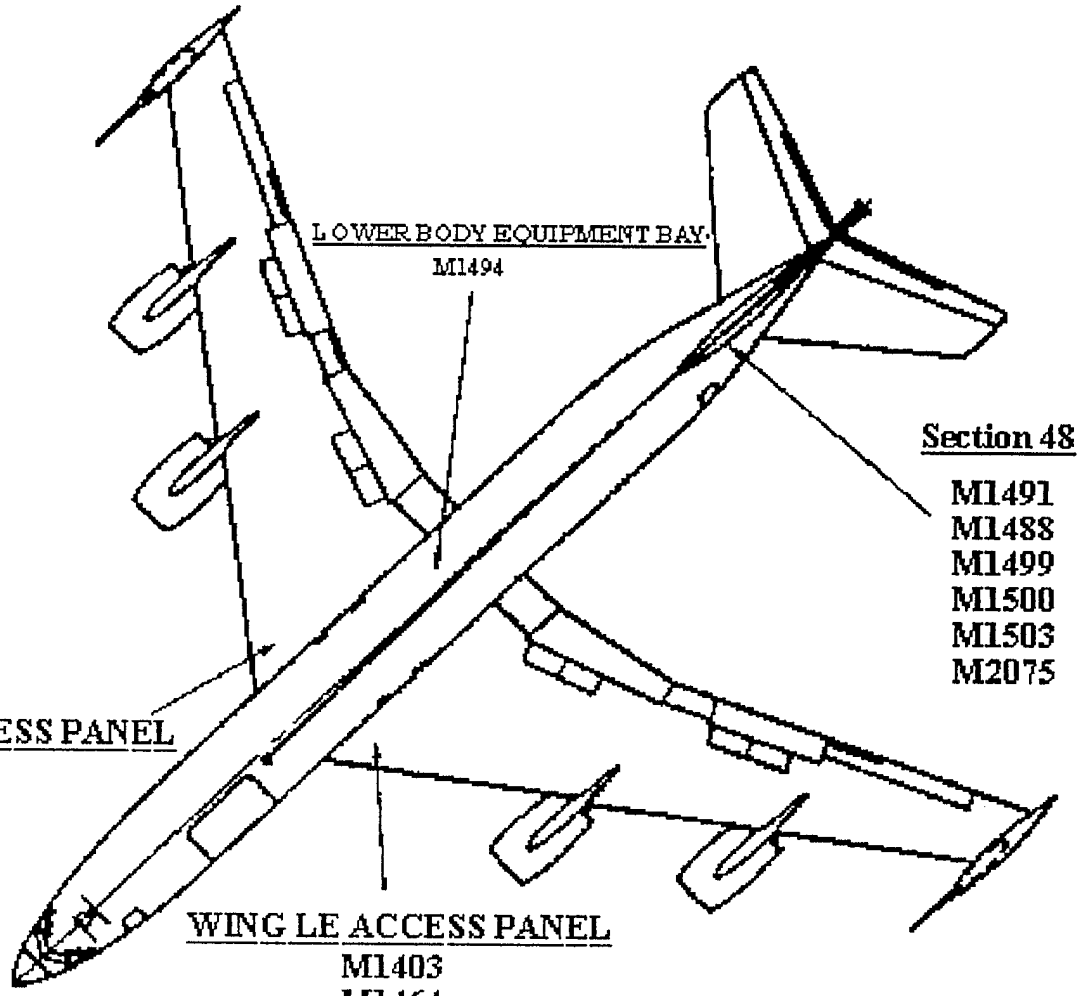
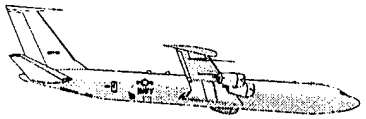






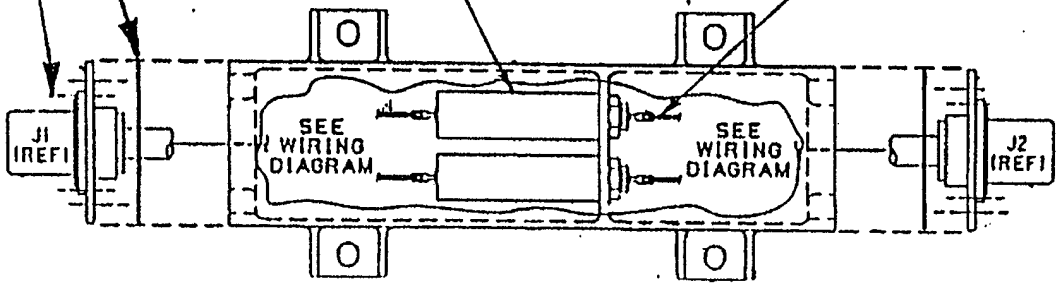
4 CAPACITOR TPM

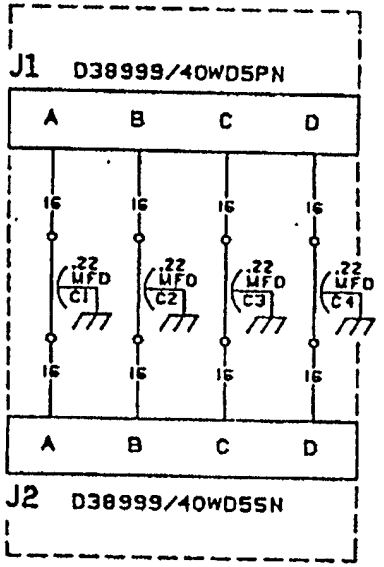
MIL-C-38999, SERIES IV CONNECTOR INSTALLED PER BAC5121, BONDED PER MIL-B-5087

WIRE TYPE M22759/18 INSTALLED PER BAC5116, SOLDERED TO CAPACITOR PER BAC5044, HEAT SHRINK TUBING APPLIED PER BAC5155

CONDUCTIVE GASKET & ADHESIVE INSTALLED PER BAC5010

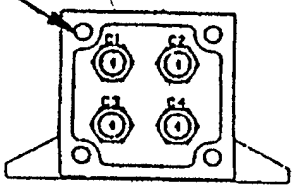
COAXIAL CAPACITOR BONDED PER MIL-B-5087, INSTALLED PER BAC 5011

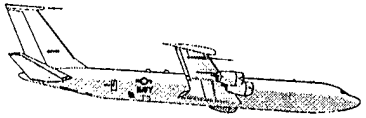




WIRING DIAGRAM

ALL BOLTS INSTALLED PER BAC 5009





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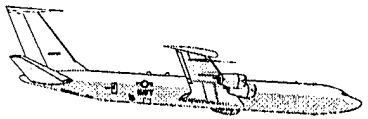
E-6 HM/HS RESULTS

- External TPM's Continue To Be A Problem
  - Water Intrusion Causes Corrosion Requiring Remove and Replace
  - Engineering Change In Process



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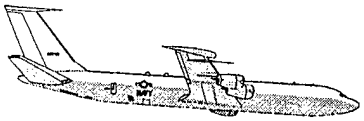
E-6 HM/HS RESULTS (Cont'd)

- 10% Of External TPM's Tested Fail "Initially"
  - Excessive Amount Of Water Displacement Compound Inside Connectors
  - Most TPM's Check Good After Being Cleaned, Dried & Retested
- Failure Modes Are Generally Passive - Few Aircraft Downing Discrepancies



E-6 E^3 HM/HS DATABASE

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QUALIFICATION TEST

EMP RELATED SCHEDULED MAINTENANCE

PRODUCTION TEST

DATABASE

EMP RELATED UNSCHEDULED MAINTENANCE

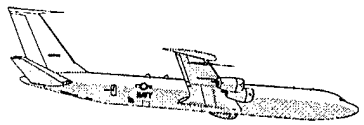
SURVIVABILITY ISSUES

SURVEILLANCE TEST

EMP RELATED ECPs, RAMECs, SDLM SPECIFICATIONS

R&M ISSUES

LOGISTICS SUPPORTABILITY



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CONCLUSIONS

- The TBNH-6F Provides A Quick And Effective Method For Testing TPM's For The E-6 Aircraft
- The Test Set Is A Valuable Tool In The HM/HS Process